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## FUTURE SOURCES OF POWER

By

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At present we depend almost entirely on coal, oil, natural gas, and water for power. Of the 12 million horse-power developed in the northeastern district of the United States (New England, New York, New Jersey, Pennsylvania and Maryland) about 10 million horse power is derived from coal and two million from water. If all of the water power of the northeastern district were fully developed, including storage, and the provinces of Ontario and Quebec allowed the exportation of one-half of their total of 6 million horse power each, the water powers available in the northeastern district would just about replace the present horse power developed by steam. As, however, the power requirements of the country have been doubled about every 10 years, by 1930 we should again have to fall back on coal for one-half of our power and the proportion would steadily increase thereafter. It is therefore of interest to know how our coal is holding out.

The quantity of coal in the ground can be estimated much more accurately than the quantity of oil or gas or any of the minerals. Careful estimates by the U. S. Geological Survey indicate that there were originally in the United States about  $3\frac{1}{2}$  trillion tons of coal, of which only a little over one trillion tons was east of the Mississippi River. Of the coal west of the Mississippi River about one-half is low-rank lignite, which is nearly one-half water. In this grand total Pennsylvania is estimated to have had 21 billion tons of anthracite and  $112\frac{1}{2}$  billion tons of bituminous coal, or 3.71 percent of the whole. About 6 billion tons of this anthracite have been mined or rendered unminable, leaving about 15 billion tons available; and an equal amount of bituminous coal has been mined or lost, leaving  $106\frac{1}{2}$  billion tons for the future. However, the figures include all of the coal that is likely ever to be mined, much of which is in beds too thin to be considered mineable now. Coal mining in Pennsylvania is mainly in the thick beds. Of 170 million tons of bituminous



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coal mined annually in recent years in Pennsylvania, about 100 million tons has come from the Pittsburgh bed, which is 5 to 9 feet thick. Estimates by the State Geologist show that about 8 billion tons of coal remain in that bed, which, if mined at the rate of 100 million tons per year, would last 80 years. Some of the basins, such as the Greensburg and Uniontown, will last scarcely 25 years. Therefore although the coal in Pennsylvania will not all be mined out for several hundred years, it may safely be estimated that 100 years will see the end of the thick, cheaply mined coal in the State. Pennsylvania will then have to compete with other states which have not been so rapidly using up their supply of thick coal. It must be remembered in this connection, that for many years Pennsylvania produced 2/3 of the coal mined in the United States and today produces nearly one-half.

The total original supply of oil in the United States is estimated to have been about 11 billion barrels, of which we have used one-half, leaving 5½ billion barrels for the future. (Recent estimates add about 4 billion barrels, not yet in sight, but covering all future discoveries of new fields.)


The production of oil in the United States for 1920 is now estimated at 445 million barrels. At that rate the oil will be all gone in less than 15 years. Actually, we will be pumping oil 100 years from now, but if the demand continues or increases as seems likely, an ever increasing part of our supply must come from other countries. It is probable that new methods of recovery now being used will greatly increase the quantity of oil to be obtained from many of our fields, and will correspondingly prolong their life.

It has been urged that the burning of oil under steam- or house-heating boilers or in house-heating furnaces should be prohibited; and attention is called to the fact that oil-burning marine steam engines are out of date, as shown by the experience of the Bethlehem Steel Company with sister ore ships running between Cuba and Sparrows Point, Maryland. The ship equipped with Diesel type of internal combustion engines shows greater economy in fuel than the ship burning oil under boilers.

Another and as yet unused source of oil is the oil shale which occurs in great deposits in the western and in some of the eastern states. Gasoline will not have to go much higher before oil from shales could be distilled with financial success. As, according to estimates, Colorado and Utah have deposits of oil shale large enough to yield 20 billion barrels of oil, and some of the eastern states have even more though of a much lower grade, people need not worry about oil rising in price indefinitely. Already a number of plants are experimenting on the production of oil from shale on a commercial basis.

Natural gas has been so abundant that it has been used wastefully. As a result the natural gas resources of Pennsylvania, West Virginia, and Ohio are now on the decline. This fuel doubtless will be reserved more and more for household cooking purposes and therefore cannot be counted upon as a future source of power.





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As with coal, the most cheaply developed water powers have in the main already been developed, and future water power development will be at an ever increasing cost per horse power.

Although coal will last several hundred years it does not require a prophet to see that the time will come when it will be all gone, and while the large water powers will meet some of the demand for many years to come, they cannot supply all the power needed. Either our use of power must ultimately slow down to that supplied by water or we must find other sources.

A brief study shows that the use of wood alcohol or other vegetable sources will always be insignificant. With cheaper electrical storage the wind may some day become a large source of power. The American type of windmill requires about a 20 foot wheel to develop one horse power in a 15 mile wind. The horse power increases in proportion to the area of the wheel and increases very rapidly with the increased velocity of the wind. Some power has been developed in the past from the tides and more may be developed in the future. Power from waves is now being experimented with. All of these means of developing power, however, involve such large outlays of capital as to be commercially impracticable under present conditions.

The direct use of the sun's rays is another problem. From time to time engines run by solar heat have been tried. Ericsson, the inventor, spent 15 years and \$100,000 in a study of the problem. The net result of his experiments coupled with our advanced knowledge of storage and transmission of electricity, holds out the strong hope that eventually we will be able to obtain any amount of power directly from the sun. Experiments show that under a vertical sun without clouds, an average of one horse power per square yard of the earth's surface can be developed for 9 hours a day. Ericsson's figures indicate that the rainless desert areas of the earth's surface should be able to supply the world with hundreds of millions of horse power.

Finally there is the possibility of unloosening the energy of the atoms. When in March 1903, Curie and Laborde discovered that a gram of radium without any combustion emitted enough heat to raise its own weight of water 100 degrees in an hour, there was opened the gate of a new realm. Thompson has calculated that a gram of hydrogen has within it enough energy if set loose to raise 1 million tons of water over 100 yards, and some people have expressed the notion that after we have learned how to obtain the energy locked up in the atoms, some fellow some day will lose his control of an atom and blow the whole solar system into star dust.



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